Written evidence submitted by the University of Sheffield (EVP0112)

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The EPSRC Centre for Doctoral Training (CDT) in Energy Storage and its Applications is a joint Centre delivered by the Universities of Sheffield (lead) and Southampton. It has recruited a total of 53 PhD students, starting in Oct 2014, and delivered bespoke training and research activities within the energy storage field (www.energystorage-cdt.ac.uk).

Abbreviations

ICE - Internal Combustion Engine
EV - Electric Vehicle
HGV - Heavy Goods Vehicle

Executive Summary

1. Our main policy recommendations are:
    a. Invest in Electric Vehicle (EV), battery cell/pack manufacturing and charging infrastructure;
    b. Invest in renewable electricity generation and grid reinforcement;
    c. Further research into batteries or fuel cell use for buses / heavy goods vehicles;
    d. Mandate usage of EVs by Government institutions and public services;
    e. Invest in public transport especially trains & buses due to ease of electrification, and ensure cost competitiveness versus road vehicle usage;
    f. Changes to vehicle excise and fuel duty are required to relate to mileage/insurance/MOT as a means of recouping lost revenue;
    g. Incentivise uptake of EV & engage in schemes to enhance public perception of EVs and the EV network.

Accelerating the shift to zero emission vehicles

The feasibility, opportunities, and challenges presented by the acceleration of the ban of the sale of new petrol and diesel vehicles to 2030;

2. **Feasibility:** This is difficult to answer. Yes, electric vehicles are now available, battery costs are reducing downwards, but they are still expensive and we don't yet have the infrastructure to generate enough renewable energy and provide adequate charging facilities. One view is that it is better to implement the change to EVs now, rather than wait for renewables to be

fully developed. The feasibility will depend on level of investment in the technology and infrastructure; availability of raw materials, supply chain and workforce, and the buy in by consumers.

3. **Opportunities:** There is an opportunity to reduce the environmental impact of transport in terms of reducing emissions and CO_2. There is also an opportunity to improve the quality of life of the population, especially if that is accompanied with encouraging remote or local working and an improvement in public transport, all of which will help reduce health services costs and the cost of crimes and policing. There is an opportunity to create new jobs to manufacture and recycle electric vehicles and their components and supporting infrastructure and services. With increased uptake of EVs there is also an opportunity to change public perception of EV ownership and usage

4. **Challenges:** One challenge is to ensure that enough renewable / clean energy capacity is available for the increased demand caused by more EVs. To facilitate this there also needs to be a reduction in energy demand in general and car usage in particular. This could be achieved by improving public transport and reducing the need for commuting.

5. Another challenge is to ensure that the sourcing of raw materials, components and EVs is done in an ethical and sustainable manner. This is especially challenging as many poorer countries are associated with this supply chain. Fair and environmentally sound sourcing of the resources needed to build the electric vehicles is essential if we are to realise the benefits of decarbonising transport; there is not much point in improving things in the UK and rich countries by shifting the pollution and exploitation to poor countries.

6. There is also a challenge surrounding plug-in hybrids that also use petrol and diesel in that many current users of such vehicles hardly use the electric only feature. There could be a danger that this current trend will continue significantly reducing the environmental benefit of purchasing and EV.

7. There is also a challenge associated with ensuring charging facilities are available for low income families, many of whom do not have access to off road parking and hence may be disproportionately affected by a ban on non-electric vehicles. There are also issues with the cost of EVs at present. Some of this may be resolved as the second hand EV market increases but there is still a danger that many people will continue to use non-EV cars for years after the ban, especially as the ban only relates to new cars and not to the second hand market.

8. Public perception will be a significant barrier and any policy needs to be adequately explained in layman terms. There is likely to be significant scrutiny of any push toward increased EV ownership from the media and wider public.

The actions required by Government and private operators to encourage greater uptake of electric vehicles and the infrastructure required to support them;

7. Increase funding to help support development of vehicle technology and infrastructure

8. Evidence Government leadership via an early shift to using electric vehicles by public institutions (police, councils, etc.).

9. Change regulations and taxation to favour UK manufacture (e.g. JLR, Britishvolt etc.), production and use of electric vehicles. Create an effective set of import/export legislation to encourage trade of EVs.

10. Invest in public transport, such as the rail network which requires further electrification and EV charging stations at park and ride stations.

11. Encourage shift to remote working, which was demonstrated to be doable and effective by the COVID pandemic, to reduce commuting and reduce energy usage

12. Continue to invest in clean sources of electricity generation to underpin the clean, sustainable re-charging supply for future EV fleets.

13. The life-cycle energy requirement for EVs needs to be considered, starting from mining and processing and transport of the raw materials and ending with recycling the used batteries, motors and other components to ensure long term sustainability and minimise the environmental impact.

14. Invest in research and development of materials and components for electric vehicles; support manufacturers, recyclers and service providers; introduce regulations and taxation reforms to facilitate the manufacture or import of electric vehicles, chargers and renewable energy components and services; invest in public transport; ensure that the sourcing of materials, components, systems or services is ethical, environmentally sound and fair and does not rely on exploitation of people in poor countries; invest in public transport and encourage remote or local working; introduce regulations to reduce energy usage (improve home insulation, improve efficiency of devices, reduce need to commute and transport goods from far away places, etc.)

15. To secure the long-term future of lithium-ion battery production, a localised supply chain should be established which would reduce the cost of batteries. Cornish Lithium has exemplified this and boosted awareness and commercial interest in this area, but cathode

materials (which consists of 56% of the battery material costs) would be needed to establish a thorough supply chain. Cathode materials consist of Nickel, Manganese, Cobalt, Iron and Phosphorus; most of which have been found in various sites around the UK by the British Geology Society. The Cairngorms, Lake District, North Scotland, and Cornwall/Devon host many of the minerals that can be used in cathode production. This will however need to be done with care as public perception could be negative towards exploiting areas of natural beauty.

16. This solution will be long term due to the time it takes to establish and build mines and the corresponding supply chain, so it is unlikely that this will be finished before 2050. Different battery chemistries are being developed and researched that may be more suitable for the British mineral distribution, for example sodium-ion batteries, which could be sourced using pre-existing infrastructure like the salt mining in Cheshire).
    Stats Source:
    www2.bgs.ac.uk/mineralsuk/statistics/rawMaterialsForALowCarbonFuture

17. There is a need for investment in residential on street changing facilities for people without access to off street parking, in addition to widespread investment into deployment of public charging stations. There is a perception that charging stations are too sparse and this leads to reluctance on the part of prospective EV owners.

18. Tax incentives and grants to enable the less well-off to buy EVs, which are currently mostly owned by

19. Low cost electric-vehicle conversions (as low as £900), which will help reduce prices.

The particular challenges around decarbonising buses and how these should be addressed;

20. The main challenge will be charging the large batteries or refuelling fuel cells quickly enough. This would need to be done when out-of-service to eliminate any safety concerns.

21. China's olympic buses demonstrated that this could be overcome by quick battery replacement schemes. But new types of battery and fast charger technology can offer an alternative solution.

22. On average, buses travel ~100 miles/day in the UK (~82 miles/day in London). This opens the potential for second life EV batteries to be used in this market as they do not require the full 250-300 mile capacity that new batteries are designed for. Alternatively, cheaper lithium iron phosphate batteries could be used to lower the cost of electric buses. Both of these

solutions can reduce the cost of electric buses while facilitating overnight charging while out-of-service.

23. With hydrogen heating creating a hydrogen grid, then busses / lorries and other vehicles could use hydrogen to allow them to be used more constantly - especially with self driving vehicles coming in, there would be no reason for a lorry to not be on the road (as there would be no driver breaks).
    Stats source:
    https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/929992/annual-bus-statistics-year-ending-march-2020.pdf

The Government's ambition to phase out the sale of new diesel heavy goods vehicles, including the scope to use hydrogen as an alternative fuel.

24. This is a reasonable ambition that goes hand-in-hand with decarbonising bus and car transport. To facilitate this, the responsibility would fall on the OEMs to manufacture alternatively-fuelled HGVs and equally the government and commercial development of the vehicular charging infrastructure.

25. There are 8 hydrogen charging stations in the UK, most in and around London, one in Sheffield. This restricts the integration of hydrogen technology if there's nowhere to charge a vehicle. Due to the (perceived) danger of hydrogen, initial deployment in rural areas and motorways first would be advised due to lower population densities, ease of charge, and the ability to travel further on one charge.

26. Moving more freight to the rail network would help speed this process, although further investments in the rail infrastructure to accommodate this would be required. HGV traffic and large warehouse locations closely align with the existing rail network layout, therefore further increases in rail capacity could reduce the requirement for HGVs.
    https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/777781/fom_understanding_freight_transport_system.pdf

<u>Road pricing</u>

The case for introducing some form of road pricing and the economic, fiscal, environmental and social impacts of doing so;

27. Road pricing will require investment in the infrastructure that will enable that to happen (NationalGrid, "Supporting the growth of electric vehicles", January 2019).

28. Increasing general taxation to account for the loss of revenue from the removal of ICE vehicles would likely be met with opposition, any form of replacement tax will need to be straightforward and easily explained.

29. To mitigate subsidising heavy car users, a simple road tax related to mileage usage could be introduced, using the existing road tax system with its link to MOT and insurance, which will continue to serve the purpose of ensuring the safety of vehicles on the road.

30. One could argue that this is equivalent to a tax on fuel, which is also directly related to the number of miles someone drives. However this would affect people who live in rural areas more, so would require careful impact studies to be undertaken.

31. A related concern is to define what the impact on people that would continue to own and run non-EV cars after 2030. Fuel duty tax would need to remain for a period of time significant enough to prevent second hand non-EVs becoming more desirable due to a reduction in fuel costs. A well-signposted gradual increase in fuel duty tax advertised in advance could lead to a more natural transition to EVs.

32. A road mileage tax system is effectively a 'pay as you drive' model and could work similar to current motorbike insurance which requires the user to define their expected annual mileage: the user pays more if this mileage declaration is exceeded. This could be banded depending on car size, which may be correlated to car usage (and income).

33. People could be incentivised to drive/own an EV in a similar fashion to 'cycle to work' schemes, and this may be linked to tax/road pricing, at least in the short term. There are existing salary sacrifice schemes to help purchase of EVs already exist, e.g. from Tusker Direct (https://www.tuskerdirect.com/products) to help mitigate the purchase price of new EVs.

34. A further option would be to increase fuel duty, however this could result in penalising the poor in society, as currently EV owners tended to be the wealthier segment of society, hence continued combustion engined vehicle ownership and usage by the less well-off would be a double disadvantage (higher EV purchase price and increased fuel duty).

Which particular road pricing or pay-as-you-drive schemes would be most appropriate for the UK context and the practicalities of implementing such schemes;

35. Electric Vehicle road tax could be reclaimed at MOT/ annual service level by officials recording the mileage difference on the mileometer. Depending on the magnitude of the tax, this could overwhelm low socio-economic families financially who have to also pay for the

MOT/service/ vehicle repairs. A system similar to the utility meter could resolve this and be fair for all vehicle users. This would involve users recording and paying each month/quarter, then pay the difference at the MOT.

36. Due to an increase in new (electric) vehicles and vehicle leases, which don't require an MOT/service for the first three years of use, an alternative tracking system would need to be developed, perhaps an annual 'review' by the manufacturer/leaser could encompass this.

37. Some insurance companies are using blackboxes to record driver data. In theory this system could be adapted to record mileage if rolled out to the whole population. But care must be taken with respect to protecting driver information (e.g. identity, geographical location) and provide sufficient data protection to any data stored.

The level of public support for road pricing and how the views of the public need to be considered in the development of any road pricing scheme;

38. Taxation is complex and not fully understood by the public. Road pricing would need to be proportional or progressive tax in order to appease the public. The tolling of major roads may be an alternative method of recuperating the road tax losses, with the M6 Toll having a revenue of £89 million in 2017 over it's 27 mile length. Despite the increase in usage, the company owning the M6 toll (IFM) is suffering financially from the interest rates from the construction cost loans.

    Stats source:
    www.expressandstar.com/news/business/2018/10/02/m6toll-revenue-hits-89m-as-183m-vehicles-use-pay-motorway/

39. A new tax that may be unpopular in a similar way to toll roads, as it may feel like you are being punished for driving. Fuel tax is incorporated with a product so it's generally a bit more understood by the public as opposed to a toll road which can be seen as paying for an optional service, with some drivers opting to take alternative routes in order to avoid the cost. This would also be seen as a more uniform, fair taxation across the population, with drivers being purely taxed on the fuel usage as opposed to their geographical location with respect to the toll roads.

40. Public perception will need to be managed carefully in order to enable an effective rollout of any road pricing system. It is likely that the introduction of a road pricing system would be unpopular without detailed promotion and explanation.

The lessons to be learned from other countries who are seeking to decarbonise road transport and/or utilise forms of road pricing.

41. China is prominent in the battery industry, with a strong supply chain of battery materials and has the highest number of EVs. The structure of their cities and consequent driving habits have meant that cheap, short-range electric vehicles are preferred, which can be reflected in the choice of battery chemistry.

42. The Chinese government subsidies EVs based on the vehicle range, increasing the commercial competition. Due to uptake, the subsidies have been gradually cut, with this seeing a reduction in EV uptake month-by-month. This has coincided with an increase in fuel tax in a green-energy reform.

    Stats sourced:
    https://fortune.com/2021/01/05/china-electric-vehicle-subsidies-sales-tesla/
    https://www.climatechangenews.com/2017/01/09/china-emerges-as-green-reformer-in-vast-petrol-tax-study/

43. Geographically, California may be the most applicable region to compare with the UK due to its size, population and population density. California have initiated a policy that avoids the dependency of subsidies by implementing a sales model that artificially inflates the price of ICE vehicles while reducing EV prices.

    Stats sourced:
    https://www.ft.com/content/c3e1a66e-49b1-4844-9e22-f773c9747cdb

44. Norway is a European country with a high uptake of EVs due to the high tax rate on ICE vehicles, with EVs outselling ICEs for the first time in 2020. One method of sourcing vehicle-related taxing is through the use of toll roads.
    Stats sourced:
    www.autopass.no/en/about-autopass/organization-of-autopass#:~:text=The%20use%20of%20road%20tolls,pass%20straight%20through%20without%20stopping.

February 2021